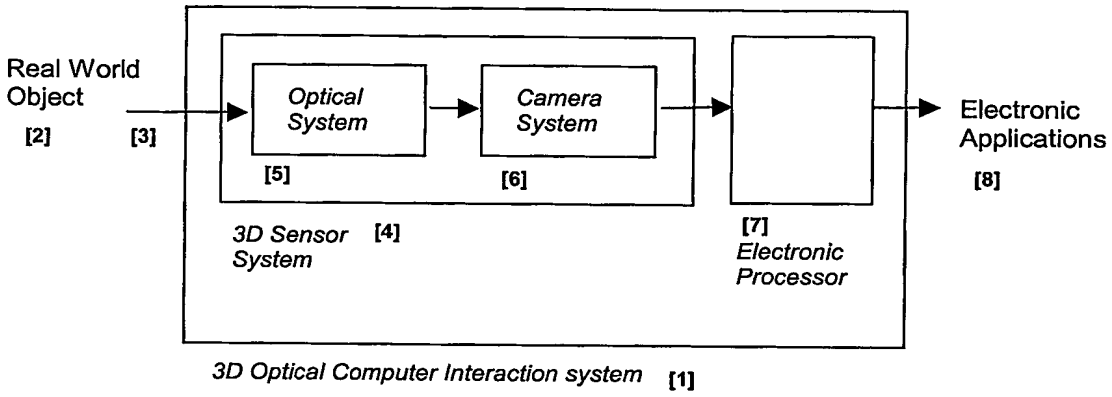

Real World Object
[2]
[3]
Optical System
[5]
Camera System
[6]
3D Sensor System
[4]
[7]
Electronic Processor
Electronic Applications
[8]
3D Optical Computer Interaction system
[1]

Fig. 1

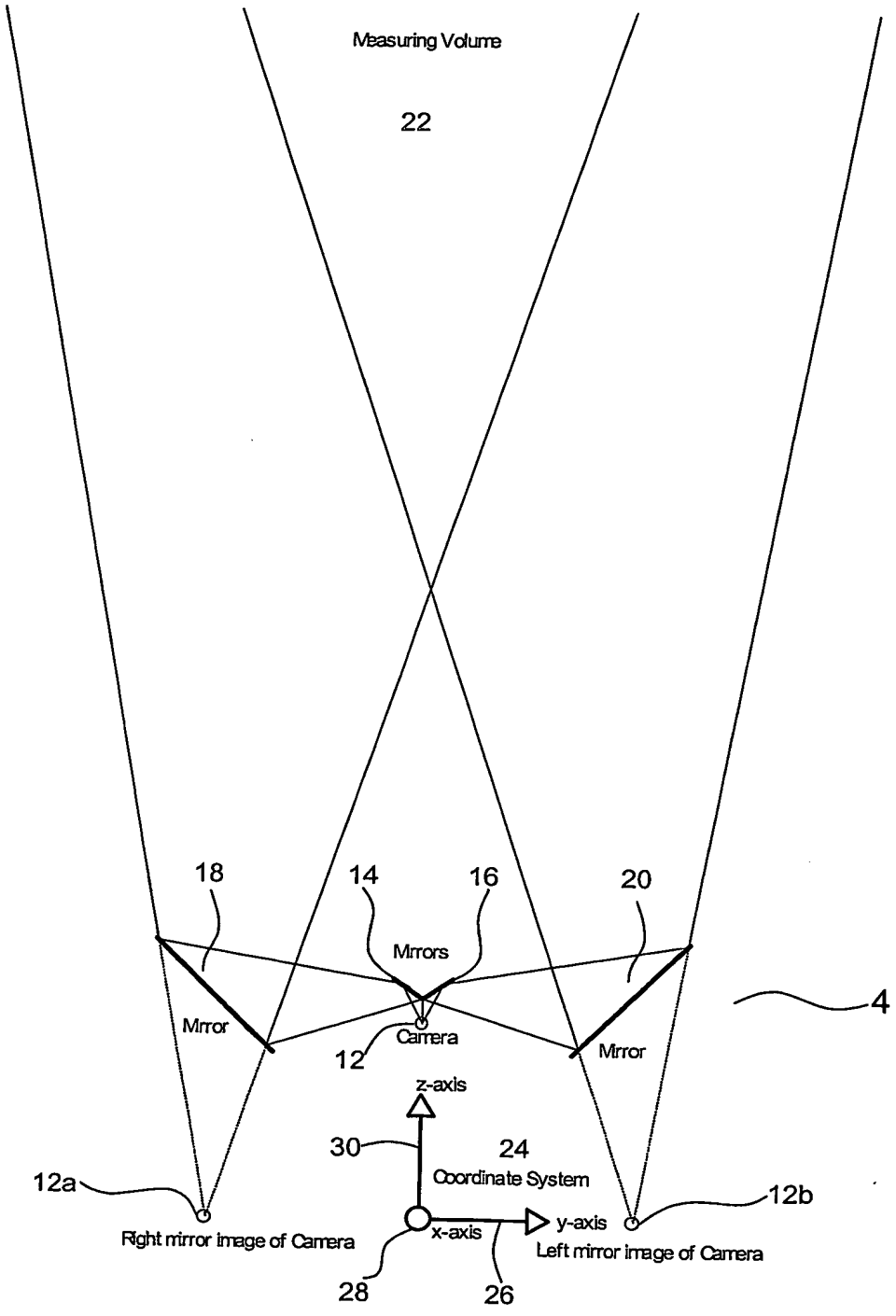

Measuring Volume
22
18
14
16
20
Mirrors
Mirror
Mirror
4
Camera
12
z-axis
30
24
Coordinate System
12a
12b
x-axis
y-axis
Right mirror image of Camera
Left mirror image of Camera
28
26

Fig. 2

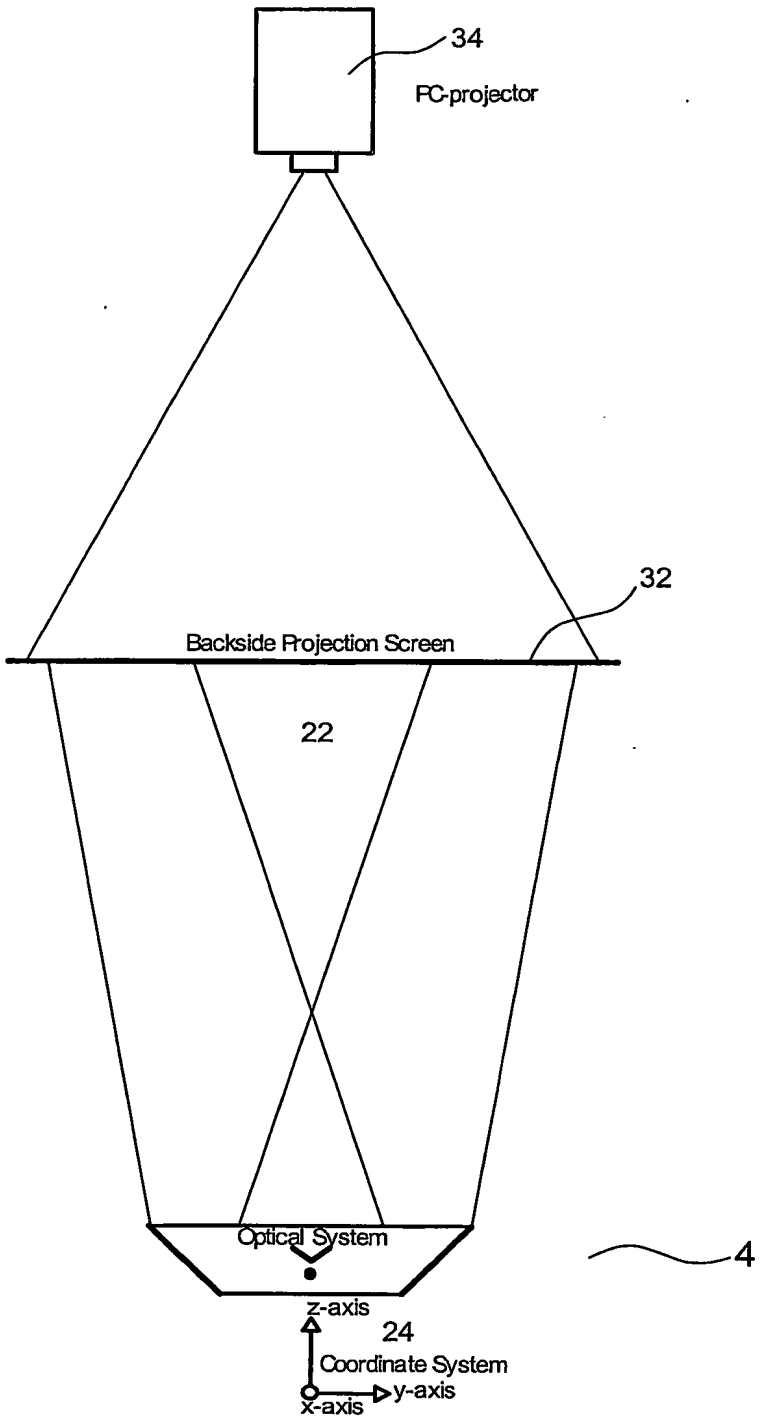

34
PC-projector
32
Backside Projection Screen
22
Optical System
4
z-axis
24
Coordinate System
y-axis
x-axis

Fig. 3

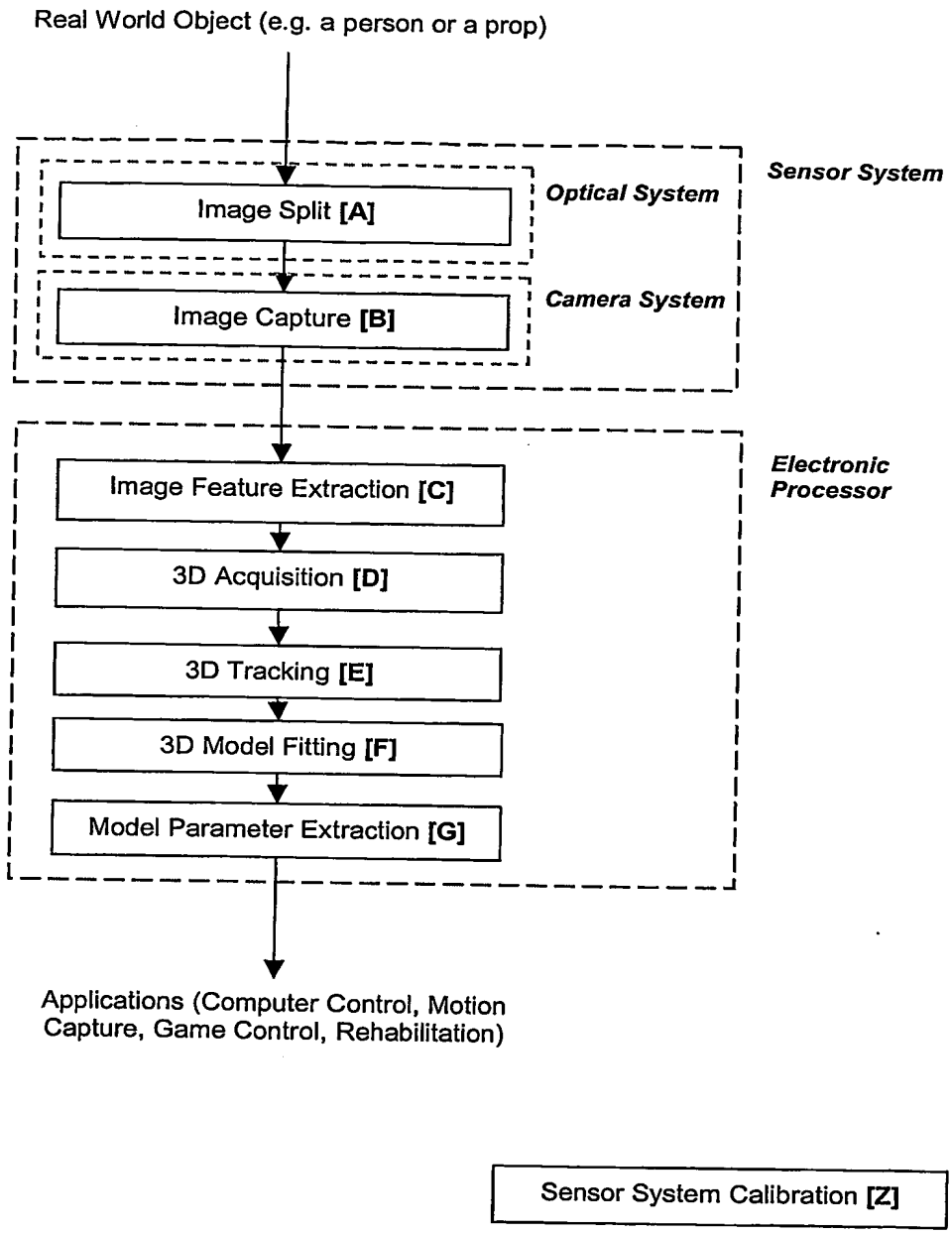
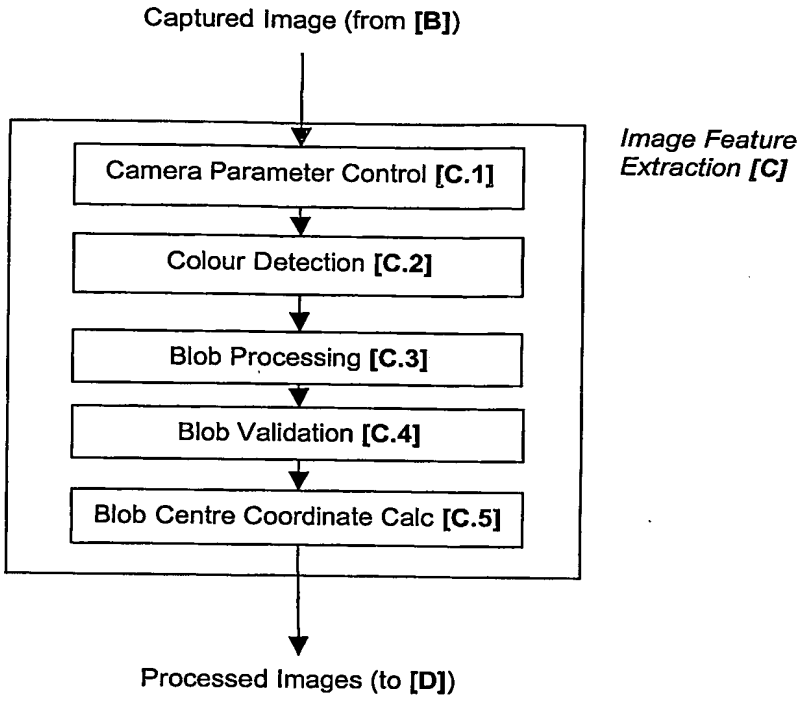

Real World Object (e.g. a person or a prop)
Sensor System
Optical System
Image Split [A]
Camera System
Image Capture [B]
Electronic Processor
Image Feature Extraction [C]
3D Acquisition [D]
3D Tracking [E]
3D Model Fitting [F]
Model Parameter Extraction [G]
Applications (Computer Control, Motion Capture, Game Control, Rehabilitation)
Sensor System Calibration [Z]

Fig. 4a

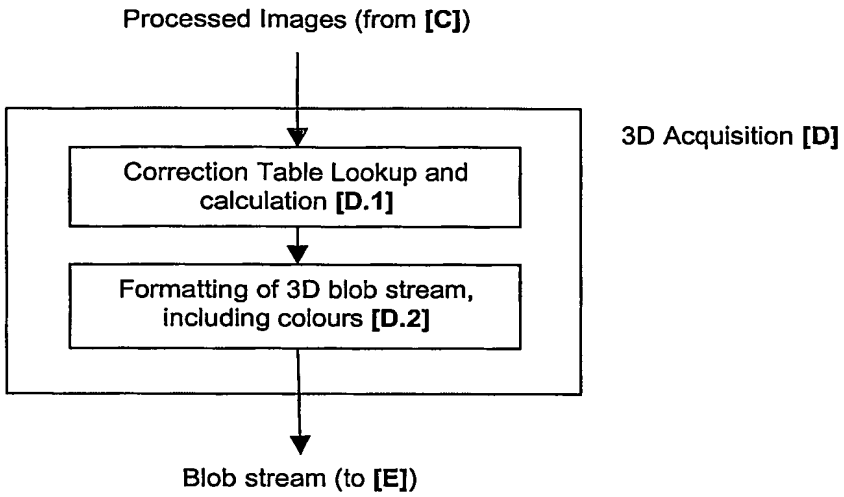
ID	Process Name	
[A]	Image Split	The optical device is to forms a pair of images in the camera with different points of view, thus forming a stereoscopic image by optical means.
[B]	Image Capture Process	The image capture process is performed by a standard low-cost camera with a standard USB of Firewire PC interface. The advantage of using a single camera to obtain stereo images is that the images are captured at the same time and with the same focal length of the lens, as well as the same spectral response, gain and most other parameters of the camera. The interfacing is simple and no synchronisation of more cameras is required.
[C]	Image Feature Extraction process	The extraction process detects skin and colour of some objects attached to the person. (The process is detailed in Fig. 5)
[D]	3D Acquisition	The Image Feature Extraction process is sub-divided. See Fig. 6
[E]	3D Tracking	The Image Feature Extraction process is sub-divided. See Fig. 7
[F]	3D Model Fitting	The observed and tracked 3D points are fitted to a 3D hierarchical model.
[G]	Model Parameter Extraction	Parameters pertaining to the 3D model are extracted from the model
[Z]	Sensor System Calibration	This process performs a calibration for the complete sensor system (both Camera and optical system). The calibration thus removes errors in the lens and mirrors.

Fig. 4b



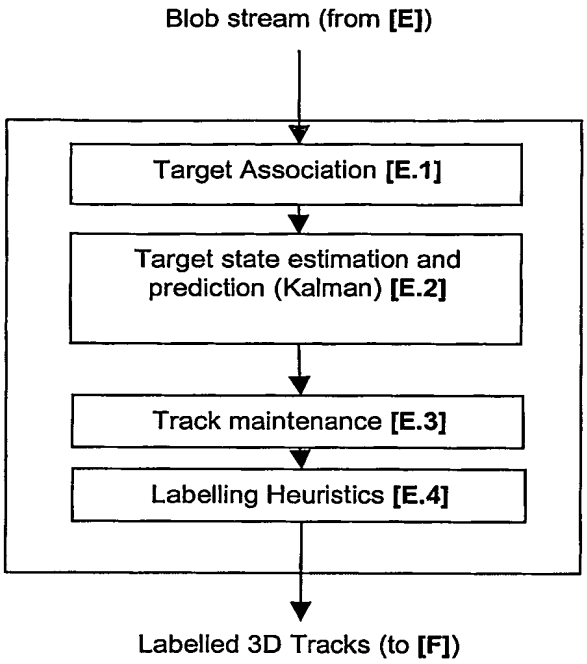
ID	Process Name	Abstract
[C.1]	Camera Parameter Control	The camera parameters are set (like gain, shutter-speed, image-size, gamma level, white balance)
[C.2]	Colour Detection	The detection of skin follows a well known formula where the calculation is performed on each pixel. The calculation is a Boolean function of the value of the colours red, green and blue, RGB
[C.3]	Blob Processing	Finding continuous areas of pixels of a given colour
[C.4]	Blob Validation	A relation between blobs is established in order to test if the pairing is feasible further down the pipe-line.
[C.5]	Blob Centre Coordinate Calc	The centre of detected blobs are calculated

Fig. 5



ID	Process Name	
[D.1]	Correction Table Lookup and calculation	For each blob-centre in a pair a lookup table entry determines the slope of the line of sight for both images of the camera. If the blob-centres correspond to an actual object then the position can be determined. Since the geometry of the camera and optical front-end is known, the calculation of the 3D position is done by triangulation.
[D.2]	Formatting of 3D blob stream, including colours	For every frame in the video-stream the calculated 3D-point set - together with their corresponding color-code - is formatted into a 'blob stream'.

Fig. 6



3D Tracking [E]

ID	Process Name	
[E.1]	Target Association	Observed targets are associated with existing tracks
[E.2]	Target state estimation and prediction (Kalman)	Trackstates are estimated and predicted by a linear Kalman filter
[E.3]	Track maintenance	CRUD (Create, Read Update and Delete) operations are performed on tracks.
[E.4]	Labelling Heuristics	Tracks are labelled according to some basic heuristics.

Fig. 7